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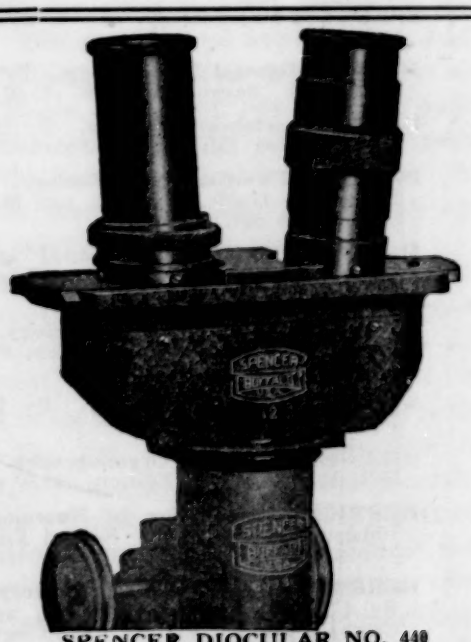

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A Weekly Journal devoted to the Advancement of Science, publishing the official notices and proceedings of the American Association for the Advancement of Science, edited by J. McKeen Cattell and published every Friday by

THE SCIENCE PRESS

11 Liberty St., Utica, N. Y. Garrison, N. Y.
New York City: Grand Central Terminal

Annual Subscription, $6.00. Single Copies, 15 Cts.

Entered as second-class matter January 21, 1922, at the Post Office at Utica, N. Y., under the Act of March 3, 1879.

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A GRADUATE SCHOOL OF GEOGRAPHY[1]

A CASTLE IN THE AIR

IN spite of a wide-spread prejudice against building castles in the air, I propose this afternoon to consider a construction of that kind; for if castles are not to be built in the air, where in the world are they to be built; surely not underground or in the water! All the castles I have ever seen were built in the air; their foundations were in the ground, of course, but the castles themselves were in the air. My proposal therefore needs no defense.

In view of the good number of castles already built, some of them very high in the air, even on mountain tops, for occupation by the defendants of various sciences, it is gratifying to learn that plans are advancing for the erection here in Worcester of a castle of the particular kind in which my own interest is most excited, a geographical castle. But it is on the other hand regrettable to find that the proposal to erect a castle, a stronghold, dedicated to geography alone seems, even in intellectual circles, to need explanation if not justification; so little is the vast and varied content of geography understood, so imperfectly is the great opportunity for original research in geography appreciated, so halting is the recognition of the importance that the results of such research will have in the conservation and consecration of the wide spaces of the earth to the better advantage of mankind. Let us try to rise to a realization of the geographical opportunity before us.

THE EPOCH OF GEOGRAPHICAL DESCRIPTION

We must remember that the geographical epoch, in which the first discovery of the gen-

[1] An address at the annual commencement of Clark University, Worcester, Mass., on June 12, 1922.

eral outline of the lands and waters over the world was made, is now closed. The work that remains for the coming geographical epoch is not the discovery but the description of the earth's features; and their description can be properly prepared only by professional geographers, unlike in disposition and training to the bold pathfinders who made the first entry into remote and unknown regions. Moreover, the labor involved in the future preparation of such descriptions will be enormously greater than that already expended in the epoch of discovery. I fear that few persons have any idea of how much geographical work remains to be done or of the amount of labor demanded in doing it. Let me tell you that even most of our own states, for example, Tennessee or Montana, familiar by name to all of us and well known locally in an empirical way to many of their inhabitants, have not yet been described with professional thoroness. There are absolutely no treatises, not even handbooks in which the regional geography of most of our states is set forth in a thoroly competent and comprehensive manner. How vastly ignorant then must we be of South America, Africa and Asia! The geography of the world is really yet to be written, and in preparation for that writing the world must be explored all over again, not by mere travellers, but by geographical experts. In order to carry on the re-exploration of the world and give adequate opportunity for the preparation of the many scholarly volumes in which a competent description of the re-explored world shall be contained, many institutions in all parts of the world must cooperate; and one of those institutions should be the geographical stronghold which we hope to see erected here.

THE ESSENTIAL OBJECTS OF A GEOGRAPHICAL STRONGHOLD

What is the essential object of such a stronghold? In the first place, the object of a geographical stronghold may be most advantageously reached if it is built up over a well planned lower story in which introductory collegiate instruction shall be offered in geography and other undergraduate subjects; but in the stronghold itself the object should be primarily geographical research and only secondarily geographical teaching. Let me at once make clear and insist upon this main reason for the construction of a geographical stronghold. It should not be planned primarily to provide either introductory or utilitarian instruction, altho such instruction should not be altogether excluded from it. The main reason for the construction and maintenance of the stronghold should be to *add geographical contributions to the sum of human knowledge,* without regard to what is called their practical value. Immediate usefulness, direct application of the knowledge gained should not be made a prime requisite in an institution of research; and particularly not in a geographical stronghold, because the higher branches of geography are as yet so little developed. The essential tasks of a geographical stronghold will therefore not be the imparting of geographical knowledge so that it may be imparted again elsewhere, as in teaching; or so that it may be applied elsewhere, as in geographical engineering—I will explain later what geographical engineering is. If the work be mainly of that utilitarian nature, the stronghold will be, from the point of view which I wish to insist upon, largely a failure.

The first duty of a geographical stronghold—or, to use its proper name, of a Graduate School of Geography—must be geographical research; and until such research has advanced well beyond its present limits the acquisition and not the dissemination of geographical knowledge must be the main object in view; the dissemination of the acquired knowledge will follow as a secondary duty. It may be well urged for many years to come that, even in the case of graduate students, the best way to prepare them for the higher reaches of geographical science will not be to impart to them the geographical knowledge already gained; teaching of that kind is properly the task of a college. The correspondingly proper task of a professional graduate school is the cultivation of proficiency in the pursuit of new knowledge; and such proficiency is best acquired not by direct instruction in formal lecture courses, but by placing those who wish to acquire it in close association with others who, already proficient, are using their proficiency in research.

RESEARCH THE BEST PREPARATION FOR HIGH-GRADE PRACTICAL WORK

Geography is not peculiar in that respect. I have it on good authority that even in chemistry, a science of enormous practical importance, the best training for a chemical engineer is not alone the study of those chemical processes which are already known to have practical value, but the investigation of new processes without regard to their application; and this for the good reason that the essential thing for the really proficient chemical engineer is not simply to know this or that treatment of a problem which has already been solved, but to know how best to attack and solve new problems. Knowledge of that sort comes best by attacking and trying to solve new problems, under the guidance of experts who are themselves chiefly engaged in solving new problems. So with the development of a really proficient geographer. It will not be enough to teach him a certain share of what is already known about geography; he must learn how to find out more than is already known; and the very best way for him to do that is to spend a few years in an institution primarily devoted to geographical research.

A STAFF OF NINE PROFESSORS OF GEOGRAPHY

Of what should such an institution consist? I have thus far described it as a castle, a stronghold; but I hardly need say that the most important elements of such a stronghold are not walls but men; geographers. They must of course have rooms to work in; and I hope that the Graduate School of Geography in Clark University will eventually occupy a large building, planned for and devoted to research; but the essential thing is the men. A strong staff of full professorial rank will be needed. There should be at least one professor for each grand division or continent, hence five in all; it would be much better to have two for each of the less known continents, South America, Africa and Asia, or eight professors in all; and another should be added for Australia, Polynesia and the oceans, thus making nine in all. Those nine geographers, or five if nine cannot be secured, would constitute the central and permanent staff of the institution. There should be a good number of others temporarily or peripherally attached, as I will explain later; and all of these should be in addition to and independent of the geographical staff for undergraduate instruction in the college.

If you suggest that one or two geographers for a continent is a lavish provision, I must insist that it is a small provision. For each geographer must be responsible for the regional description of a large area, and that means that he must know the form of its surface, its climate, its more important vegetable and animal occupants, its human inhabitants, its political subdivisions, its products and industries, and its transportation and trade. And all these subjects must be known, not as made up of isolated items unrelated to each other, but as correlated items all in their natural and interdependent juxtaposition, thus constituting the landscapes and manifesting the activities of the region. To know so much as that about a continent is no small responsibility. But in addition to this continental responsibility in regional geography, each member of the staff should be a specialist in the subject of one of the eight larger systematic divisions of geography—land and water forms, climate, plant geography, animal geography, human geography, economic geography, historical geography, and history of geography; the difference between the regional and the systematic aspects of geography being this: In each division or special subject of systematic geography, such as land and water forms, climate, and the rest, all the classes of facts treated under that subject should be studied in whatever part of the world their examples are found; while in each large division of regional geography, such as North America or Africa, all kinds of facts to whatever special subject of systematic geography they belong must be studied in their natural associations. Surely when the work to be done in a geographical stronghold is thus envisaged a permanent staff of nine men will not seem too large.

REGIONAL GEOGRAPHY THE CULMINATION OF GEOGRAPHICAL SCIENCE

Let me make it clear why I lay so much emphasis on regional geography in contrast to systematic geography. However important the different divisions of systematic geography are,

they yield only a discontinuous sort of knowledge. Under the division of land forms we may study about volcanoes, and learn as much as possible about all of them wherever they are; but the items of knowledge that we thus gain compel us to leap about all over the world in order to locate them. Similarly, we learn under human geography all about fishing villages wherever situated; but there again we must leap about to locate the items that we learn. On the other hand, the study of regional geography gives us a continuous or areal sort of knowledge. If we study the regional geography of Japan, for example, we shall learn not only the distribution of its many volcanoes and its many fishing villages, but of all its other geographical features; and it is this continuous or areal knowledge that is usually and properly implied when we speak of geography in a general way. The study of the various divisions of systematic geography has, indeed, its chief value as a preparation for the study of regional geography; hence no one should consider himself a geographer until he has become expert in the regional geography of at least one large area, preferably a continent. Moreover, not until such expertness is gained is a geographer's knowledge likely to be of practical application in such a profession as geographical engineering. A thoro representation of regional geography is therefore essential in a well developed Graduate School of Geography.

RESEARCH BY EXPLORATION

How will these nine geographers do their work? First and foremost, each one of them will be expected to take part from time to time in the actual exploration of the continent for which he is responsible, or in the investigation of his special subject in systematic geography; and between times he must make himself acquainted with the work of other explorers of his continent, and of other investigators in his special systematic subject. His own exploratory work, in which he should be accompanied by one or more advanced students, will require absence from Worcester for periods of half a year or a year every three, four or five years; and the digestion and publication of the results of his exploration will require, after he returns home, at least twice as much time as he spent in the field. The rest of his time at home should be given to the study of explorations and investigations by others, so that each one of the nine professors shall become a recognized center of absorption and radiation of regional and special knowledge. On this plan, two professors would ordinarily be absent every year; three or four others would be engrossed in preparing for publication the material they secured in the field during their absence one or two years before; and each of the remaining three or four professors would be very busy in reviewing and assimilating the work of other geographers in various parts of the world, as far as it referred to matters for which he is responsible. If under these conditions any professor finds that he has some free time left over, he might give it to the preparation and delivery of set courses of lectures.

CURATORS AND MATERIAL EQUIPMENT

You may have noticed that, apart from the staff of nine professors, nothing has yet been said about the rest of the School's establishment. While I still maintain that the essential feature of the School must be its corps of research professors, there are also other features of equipment which the professors will say are essential, even if I do not.

There must be in the first place a comprehensive library of geography and allied subjects in charge of a scholarly librarian; not simply a man who will put books back in their places on the shelves, but a man well versed in geographical literature, an active collaborator with the professors in keeping the library up to date in all its departments, and perhaps having so great an interest in geographical production as to serve as editor of the School's publications. There must be in the second place a complete collection of modern, large-scale topographical and hydrographical maps of all countries which publish such maps, and this collection should be in charge of a cartographer; not a mere draftsman, but an experienced craftsman with a real understanding of the outdoor things that maps represent and a dextrous hand for the construction of such new maps as are needed in the School work; instruction in so much of surveying and map

making as young geographers need might be given by this member of the staff. In the third place there should be a large and growing collection of models, in charge of a trained and skilful model-maker; not a mere artificer but a geographer of artistic capacity and outdoor experience, competent to design and construct truthfully expressive models himself. There should be in the fourth place an extensive and ever-growing collection of geographical photographs, not in charge of a mere photographer, but of a geographer competent to make scientific selection of characteristic views for the illustration of geographical subjects and regions. And in the fifth place there should be a comprehensive collection of the products of all countries in charge of an experienced economic geographer, unless the School proposes to depend for such material on the great Commercial Museum in Philadelphia. The material equipment of a graduate school of geography is therefore a somewhat formidable matter. It must be vigorously looked after.

A Central Bureau for Geographical Illustrations

Let me say a few words more about the collections of geographical photographs and models, in order to explain the manner in which such collections may be made useful not only in Clark University, but all over the country wherever geography has recognition. Every college where geography is taught needs a collection of lantern slides for the illustration of its lectures. At present each professor of geography in all those colleges has to build up his own collection as best he can; as a result such collections are very uneven and imperfect. There is no central bureau where well selected sets of lantern slides for the illustration of special subjects or of special regions can be obtained. What a boon it would be for professors of geography in every part of the United States if the Graduate School of Geography at Clark University would undertake to form a standard collection of photographs and lantern slides; not a finished collection, but a constantly growing collection, from which one could order, for example, an elementary set of 10 slides or an advanced set of 50 slides for the illustration of the physical geography of coasts; or an elementary set of 15 slides or an advanced set of 100 slides for the illustration of the regional geography of Colorado. A great amount of correspondence and travel, of reading and study would be required before such a collection was well developed; but when it came to be known that the sets made up from the collection were composed of pictures critically selected by a competent geographer, so that they would really accomplish their purpose, all geographical eyes would be often turned to Clark.

A Series of Geographical Models

A similarly beneficient work could be done by establishing a standard collection of geographical models, from which duplicates could be had at the cost of casting and coloring, without charge for the making. Like the lantern slides, these might illustrate both systematic and regional subjects. Thus there might be a set of five models to exhibit the successive changes of a volcanic mountain from its youth of eruptive construction to its old age of erosional degradation, and so on for other physical features. Similarly there might be models representing certain striking features of different countries. These, on account of their expense, would be less often sold to colleges than to museums where they would attract much attention; but the systematic series would surely become popular as well as serviceable in the geographical laboratories of colleges; for such models may serve not only in illustration of type forms, but as the basis for very disciplinary exercises in landscape description, a phase of geographical instruction which is too generally neglected. Such instruction may be advisedly begun in field excursions, where it can be grounded on the direct observation of nature; but the variety of landscape on which advantageous exercise may be had will be greatly extended if field excursions are supplemented by models. But I must turn away from this attractive topic, and consider again the Graduate School itself.

An Encouraging Analogy from Astronomy

If we now return to consider the work of the research professor, perhaps you will ask: Is it really worth while to study the world in so much detail as has been thus far implied. Let

me answer that question by a celestial analogy. The astronomical observatory maintained on Mt. Wilson in Southern California by the Carnegie Institution of Washington—this being a shining example of one of those lofty mountain-top castles already alluded to—has a corps of high-grade astronomers devoting all their time and abilities to the study of the sun and the stars. They have nothing whatever to do with teaching. They never stop to ask whether their discoveries will have practical application or not. But first informing themselves thoroly in all branches of astronomy as well as in the allied sciences of mathematics and physics, they perseveringly catalog and chart the stars, large and small, as so many facts of occurrence; they measure their brightness with the photometer and they analyze their composition with the spectroscope; and, marvellous to say, by combining spectrum and brightness they determine the distance of stars that are so immensely far away that they have no measurable parallax! They give the most ingenious and penetrating study to the distribution and movement of stars in space. They determine with great accuracy the periods of revolution of what are known as spectroscopic doubles, the two components of which cannot be separated even by the most powerful telescopes. Can you conceive of anything more utterly useless? And yet the world applauds their work.

The spirit of devotion to research which characterizes the staff of an astronomical observatory is the spirit which should dominate and guide the staff of a Graduate School of Geography. For if it be praiseworthy to spend years, without the least regard to what is vainly called "utility," on the construction of catalogs and classifications of stars, most of which are invisible to the naked eye and inconceivably distant from our solar system, shall it not be praiseworthy also to spend years in the study of every geographical feature in every part of the world, without the least regard to whether the study leads to utility or not? The facts of one science are of the heavens, heavenly; those of the other are of the earth, earthy. But who shall say that a ninth magnitude star in such and such a part of the sky is a more worthy object of study than a ridge or a ravine in such and such a part of the earth? The star may be very large, but it is far away; the ridge or ravine may be very small, but it is near at hand. The study of the earth, our own earth, is surely deserving of all the time and skill we can give to it. And even if, among various other geographical strongholds, the one here to be established eventually gains its quota of nine professors of geography, there will be abundant work for all to do for years and years to come. Indeed, it is highly probable that, what with the ever-growing demands of science, the scope of the work to be done in geography will be expanded about as fast as the advance of the work goes on.

The Standardization of Geography

But even as geography is now conceived, do not imagine that the staff of nine professors will find their progress to be all clear sailing, as if their courses were already charted and their duties specified. That is by no means the case. One of the most important parts of their work will be its standardization, both as to content and as to method, concerning which many problematic matters, now unsolved or imperfectly solved, must be carried to a conclusion. Let us examine first those touching the content of geography.

How shall the description of land forms be treated so as to distinguish that special division of geography from its relative in geology? How much physical meteorology shall be included in climatology? What facts concerning the plants and animals of a region shall be treated in a truly geographical essay, so that it shall not duplicate sections of botanical and zoological essays? How shall the essential factors of economic and of historical geography be treated so that they shall have a quality of their own, and not be merely selections from economics and history? All these questions must be examined and answered before the geographer can assure himself that all phases of geography, systematic as well as regional, are not merely restatements of parts of other subjects. He must see to it that all his own statements are essentially geographical statements, and of a kind that other subjects do not directly duplicate. Not that the establishment of sharp limits between the contents of

neighboring sciences is desirable, nor that trespassing upon a neighboring science is in itself undesirable; but that when a geographer has so serious a responsibility placed upon him as the regional description of a large area of the earth's surface, he is more likely to meet it if it does not dissipate his time and energy and thought upon subjects for which he is not responsible.

While I am speaking of this matter, let me add that a geographer should resent the implication made by those who argue that the interest or importance of certain non-geographical matters is reason enough for their introduction into geographical essays. To accept that argument is a confession that the truly geographical elements in geographical essays are of so little importance and interest that such essays need the stimulation of irrelevant matters. That is not true. Geography needs no padding, no seasoning by items and scraps of other subjects. It is, like them, sufficient unto itself. Did you ever hear of an astronomer or a geometer or a physicist or a botanist who thought that his science needed to be spiced up by any other in order to attract attention? Never! All kinds of subjects must be studied, and studied for themselves in this studious world; and geography is one of them. Let geography therefore be pursued as earnestly, as devotedly, as wholeheartedly and as single-mindedly as any other subject; and let it accept cheerfully and contentedly the place that it can win on its own merits in the constellation of the sciences.

THE LIMITS OF GEOGRAPHY

It is however certainly a curious thing that geography still needs the development and definition of its content in the manner that I have just intimated. One might almost call it a moron among the sciences, for altho it is very old in years it has not yet come into the full possession of its senses. It is a part of the duty of trained professional geographers to arouse and awaken their science, both by defining and by limiting its content, especially in its regional aspect which is the culmination of geography. The solution of this task is largely a question of the point of view; and the essential point of view for a geographer is one from which he can clearly see the actual constitution of a region as it exists in the "today" of human history. Let it be remembered that, as already noted, the geography of a region of the earth must include its land and water forms, its climate, its more significant plants and animals, its human inhabitants, its political divisions, its products and industries, and its trade and transportation; and that all these elements must be conceived in their actual special relations, as they exist together and interact upon one another. Regional geography is therefore an immensely complex subject, even if all non-geographical elements are excluded from it; all the more wisely therefore should a geographer hold only to truly geographical elements, as above intimated.

Indeed, even when properly limited, regional geography is so complex that some critics assert it cannot be successfully mastered and treated by one man. There is no question that it can not successfully be treated by a geographically uninformed, untrained, undisciplined man; or by a trained man who gives part of his attention to other sciences; and it may perhaps be true that it cannot be so well treated by one informed, trained and disciplined geographer working alone as by several informed, trained and disciplined geographers each responsible for a part of the total subject and all working together in a team. No decision need be made on that question now, because the problem has never been given study long enough and serious enough to answer it. My own belief however is that such a staff of professional geographers as I have indicated will, after a score of years or more, reach such a measure of success in their tasks as to show that one-man regional descriptions are of great value. But if that judgment be wrong, and if one-man geography be insufficient, the remedy is simple enough; geographical exploration must then be done by pairs of geographers, or trios, or quartettes or groups working together, each member supplementing the work of his associates. Whatever the decision is on this point matters very little today; the essential thing is that the work must be done, and done in the best way possible. So much then for the content of geography. Now for its method.

THE ART OF GEOGRAPHICAL DESCRIPTION

The staff of a Graduate School of Geography will have to take their share not only in defining and cultivating a scientific method of geographical investigation; they must also develop an artful method of geographical description. While a geographer is in the field, the subject of his investigation and his method of attacking it will occupy his mind. When he returns home the statement of his results in form for their communication to others will occupy his mind. In both occasions his mind will be fully occupied, however great its capacity. The science of investigation is somewhat technical; I can not discuss it here; but the art of presentation may be briefly considered. Many results of exploration may be best presented on maps; some results may be presented in photographs, sketches and diagrams; some in models and some in statistical tables; but the great body of results is best presented in words. Now while the geographical facts coexist simultaneously in their regions, they can not be presented simultaneously in a report upon a region; a written report must present them consecutively, word after word, line after line, page after page. It may surprise you to learn, but I believe it to be true, that the future staff of geographers in the Clark Graduate School of Geography will have a very serious problem to solve before they can establish, even in general terms a standard method of presenting or reporting upon the results of their explorations.

By such a standard method I do not mean anything rigid and inflexible; but a method that will give the reader of a report true and vivid concept of the region described. For just as accuracy is the essential object in the science of investigation, so intelligibility is the essential object in the art of presentation, and one of these high qualities is about as difficult of acquisition as the other. It is unfortunately true that certain leading geographers are stronger in the possession of their science within themselves than in its presentation to others. It would almost seem, from their preference for possession and their indifference to the fine art of presentation, that they hold possession to be in geography, as it is in the law, nine points of the whole ten; but that is an unscholarly attitude. Of what avail is knowledge if it is not clearly set forth; of what value is an obscure presentation in which at least a part of the truth is lost. I trust that no professor or student of geography in Clark University will be indifferent in this matter; for accuracy in investigation and intelligibility in presentation are correlated essentials, and hence lack of intelligibility in presentation is too often an accompaniment of a sort of carelessness that is incompatible with accuracy in investigation.

ERRORS TO BE AVOIDED

How is the art of geographical presentation to be acquired and communicated? Perhaps you may imagine that articles and reports of standard excellence in the presentation of problems in regional geography already abound, and that all that is needed is to adopt and copy their method; but such is by no means the case. In the first place a large number of articles and books commonly classed as geographical are chiefly narratives in which the narrator, often an untrained traveller, gives a leading position to his personal experiences, altho they are very subjective matters. Narrative presentation is certainly entertaining to the general reader, and it is not to be dispensed with; but it falls far short of satisfying the objective demands of scientific geography, just as the narrative of a plant collector would fall short of the demands of scientific botany.

In the second place many geographical articles and reports, altho they are presented in a descriptive instead of in a narrative form, nevertheless treat problems of less extent than those of full-fledged regional geography; they are useful contributions to the geographical science, but they fail to reach a complete regional treatment. In the third place, many articles that are in part regional are also in part analytical, in that they attempt to demonstrate an explanation for some fact or phenomenon that they describe; indeed, such articles are often largely geological, in that they turn attention away from the facts of today and direct it to the past conditions and processes by which the present-day facts have been brought about. Articles of this kind are in-

dispensable to progress, but their analytical discussions should be completed before regional description is begun; their results should be standardized and systematized before they can be properly used in regional description; and when the results are employed in their standardized and systematized form, the analysis upon which the standardization and systematization are based should not be repeated. Explanatory description in a regional essay should be used without any analytical demonstration.

THE DIFFICULTY OF REGIONAL DESCRIPTION

Finally, when regional description is attempted, it is too often inexpert in that it fails in the prime object of such description; namely, to give a vivid account of all the geographical elements of a region in their natural and interdependent combinations. Some such articles are faulty in a way that shows clearly enough how undeveloped the art of geographical presentation still is; for they leave their readers to work out, by the aid of such maps as they may possess, various details of location which the author himself ought to have made clear once for all, by map, diagram or otherwise. Many other such articles are faulty in attempting to define the location of physical features or boundaries in terms of the location of small towns or villages, the names of which are not only unknown to all readers, but undiscoverable even in good atlases! Very few such articles present at the outset a simple account of the whole region and of its subdivisions in such manner that, whenever any local feature is later mentioned, it may be at once and very easily located in terms of the introductory account; and as a result geographical descriptions are often so obscure and difficult to follow that even geographers turn aside from them, discouraged. It is as if the investigator felt indifferent to the labor that his readers must undergo before they can learn what he has done, without realizing that such indifference costs him a loss of influence.

GEOGRAPHERS AND TRAVELLERS

One of the reasons for these various deficiencies in the present status of geography deserves explicit mention: it is that the authors of articles published in the geographical periodicals of the leading geographical societies of the world are in a regrettable number of instances, not trained and disciplined geographers, but simply intelligent and observant travelers. It would seem that such persons, on visiting and returning from a little travelled region, were thereupon popularly classed as geographers, whatever they were before their travels began; and this idea is given support by the character of the membership of many geographical societies, because such membership is made up largely of generously-minded persons who, whether they have travelled or not, are glad to support the work of the societies in which they are enrolled. That they should do so is most gratifying, but that they should be regarded as geographers because of so doing is disappointing.

To return to astronomy for an illustration, do you suppose that the Astronomical Society of America is made up of intelligent persons who like to look at the nocturnal sky and recognize the constellations, and of persons who, whether they like to look at the sky or not, have pleasure in contributing to the cost of publishing an astronomical journal? Not at all; that society is made up of qualified astronomers; no others need apply. But so far as I know only one of the many geographical societies in the world limits its members to geographers; and altho its requirements for membership are not severe and altho diligent search has been made to discover as many qualified members as possible, that society has not yet succeeded in discovering 200 persons fit to be members in its country of over 100,000,000 population.

Whatever the cause of the characteristic imperfections in regional presentation to-day, it is manifest that improvements can be made only by persistent conscious effort. A large share of the attention of research professors in a Graduate School of Geography must be directed to making that effort successful.

MEANS AND MEN

It is an easy matter to outline the constitution of a Graduate School of Geography, as I have just done. It is a more serious matter to establish such a school. Obstacles of two kinds stand in the way. Those of one kind are merely difficulties; those of the other kind are

more serious, they are dangers. The difficulties are only those of finding means and men. Difficulties of that kind can be overcome in time if they are attacked energetically and persistently. Whether the means or the men will be the easier to secure I cannot say; but as to the men I believe that relatively few will be found ready made; they will have to be engaged in an immature stage and developed to maturity here and elsewhere. Of course some fully competent geographers will be brought here, ready at once to undertake research. But it is more probable that the staff will be built up gradually by the engagement and promotion of young men. A practical method to that end is to select a young man of promise and give him opportunity for growth by study and travel, during which he may specialize in one subject or another; then on his return he may be given an appointment for a term of years, and at the end of that term he may be given permanent appointment if his work has been such as to justify it. Gradual growth in some such way will I believe lead to better results than can be gained by the wholesale appointment of a full staff, even if that were possible from the financial side of the problem. In the mean time, instruction by visiting lecturers and by professors invited for a year from Europe will add to the attractiveness chiefly in the undergraduate department, of whatever regular instruction can be offered there; but neither visiting lecturers nor temporary professors from abroad can give the solidity and continuity of work that should characterize a properly constituted and truly American Graduate School of Geography. Hence if the proposed staff of nine research professors is established in 10 or 20 years, that will be doing well, remarkably well.

The Proper Standard for a Graduate School of Geography

The dangers to be met are more serious. They will arise chiefly from the pressure and urgency of students, of undergraduate rank geographically, whose needs, indeed, whose deficiencies, will tend to divert the professors of the Graduate School proper from their primary duty, research, to a secondary duty, teaching. I must here point out an essential difference between teaching and studying. In secondary schools, the teachers must do a great deal of teaching because the pupils are only just learning how to study. In colleges, the teaching by the professors and the studying by the students may about balance each other. In properly constituted graduate schools the properly prepared students should be expected to do most of their study by themselves; the duty of the graduate staff of professors is chiefly to set example and pace by doing their own research work, and to give occasional guidance to students working with them, but not to do set teaching.

Now the mere announcement that Clark University is going to establish a Graduate School of Geography will attract college graduates to come here. Some such graduates will be properly qualified by their previous studies to enter the Graduate School at once, but many of them will come from colleges where the undergraduate teaching of geography is so imperfectly developed that they will not be sufficiently grounded in the elements to enter upon truly advanced work. What shall be done with such students when they arrive here? Manifestly they should have more undergraduate instruction, but they will not like to be enrolled with undergraduates again. Yet if they are immediately admitted to the Graduate School of Geography, its standard as a school of research will be injuriously lowered.

I therefore suggest that the present graduate department of the university be continued without specification of subjects studied; and that graduates of other colleges on coming here should be enrolled in that graduate department until they have completed the requirements for admission to the Graduate School of Geography. But even so, the introductory teaching that they will need, as well as the introductory teaching needed by Clark undergraduates who propose to make geography their life work, will demand that a considerable body of undergraduate teaching in geography be offered here; and for that purpose three professors will be called for at the very least. The danger is that the research professors in the Graduate School of Geography will be drawn into this work. Naturally enough, undergraduate geography will be developed here before the Graduate

School of Geography is fully established; and with such a beginning it may be difficult to establish a Graduate School of the kind I have outlined. The college professors of geography will themselves wish to have some time for original studies; some of them will wish to give graduate instruction. And thus even if one or two research professors are added, a half-developed Graduate School of Geography may grow up, in which research is only incidental and secondary, and teaching of an undergraduate grade is the larger duty.

The very respectability of such an arrangement is ominous. It will be so good that a better arrangement, a real professional school of geography may be lost sight of; and yet a mixed school of that sort will only be "another" school of the mixed kind; and being attached to a small university instead of to a large one it will have no particular merits; it will not stand out with preeminence of its own. As I am only a commencement speaker and not a trustee, my duty goes no farther than to point out this threatening danger: it will be for others to provide safeguards against it. I may however note in passing that although a number of other universities have already reached the stage of offering geographical instruction in both their undergraduate and graduate departments, none of them thinks it worth while to segregate the graduate part of such instruction under so ambitious a name as a Graduate School of Geography; and I believe that they are quite right in not doing so because they do not propose, for the present at least, to provide opportunity for advanced work in geography so far in excess of that provided in other subjects as to warrant the announcement of a School of Geography. It is here that the opportunity for geography in Clark University is likely to be for a long time unique; because in this university geography is, if I understand the plans of the trustees correctly, to be given as great pre-eminence over other subjects of graduate study as possible. It can not reach great pre-eminence immediately, for as I have already pointed out it is not possible immediately to secure a staff of research professors. The unique feature of geographical opportunity at Clark is therefore the aim in view; namely, to establish a real Graduate School of Geography as soon as possible. The recent appointment of a geographer to the presidency of the university is evidence of the seriousness with which this aim is regarded by the trustees. They have my heartiest good wishes for their success, but it is evident that success can not be reached if the research professors in the Graduate School are distracted from their proper work by the necessity of giving undergraduate instruction.

UNDERGRADUATE PREPARATION FOR GRADUATE WORK

There is a second danger about as serious as the first. Properly qualified members of a properly constituted Graduate School of Geography ought not only to have already acquired a good understanding of fundamental undergraduate courses in geography; they should also have acquired a good understanding of some one or two other subjects allied to those systematic divisions of geography in which they propose to specialize. The requisite undergraduate courses in geography itself should represent several of the chief systematic divisions of geographical science; for example, land and water forms, climatology, human geography, economic geography; and also one or two introductory courses in regional geography, for example, North America and some other continent. These taken together should constitute the equivalent of a whole year's undergraduate work at least. But in addition thereto, a student who proposes to specialize in one or another division of systematic geography should have made good undergraduate progress in some other subject closely allied to that division.

Thus one who specializes in human geography should have taken several undergraduate courses in the allied subject of history on one hand, or in anthropology and ethnology on the other. A student who proposes to specialize in economic geography should be well prepared in the allied subject of economics; and one who selects plant geography or animal geography for his special subject of preference, should be well grounded in the allied subject of botany or zoology; and so on. These allied subjects should occupy from half a year to a

year of undergraduate study. Furthermore, a real facility in reading French and German, and, still more important, a trained capacity to write good English should be included among the results of undergraduate study. No student, of whatever college he may be a graduate, should be admitted to the Clark Graduate School of Geography if he falls seriously short in any of these undergraduate requirements. He may be admitted of course to the graduate department of the university, if he holds a bachelor's degree from any reputable collegiate institution; but so long as he has serious deficiencies in the undergraduate preparation for the graduate study of geography, he ought not to be admitted to the Clark Graduate School of Geography, or to any other such graduate school. For in just so far as a member of a professional graduate school uses his time there on undergraduate studies, he lowers the standing of the school; and any one who looks on the high standing of his school with pride should be jealous of all influences which tend to lower it.

The seriousness of this danger of unpreparedness and the importance of establishing safeguards against it ought to be manifest to any one who is familiar with the demoralizing influence exerted on a graduate student's work for a higher degree by the necessity of making up undergraduate deficiencies at the same time. Work for a higher degree should occupy a student's whole attention. If in his graduate years he is giving part of his time to undergraduate subjects, which he ought to have studied earlier, he is not only distracted thereby from his proper graduate work, but the graduate work which he does will be weakened by reason of not being based on a completed foundation. In a word, the student members of a professional graduate school ought to be well trained for the work that they have to do there; as such they would constitute a select body of which any institution must be proud.

The Difference between Studying and being taught

You may now understand better than before what was meant by my earlier insistence that teaching should not be a prime duty of the research professors in a true Graduate School of Geography; for the fact that they are not to teach does not imply that they are to have no students. Of course they are to have students, properly qualified graduate students; and the students are to study; but the professors are not to teach in the ordinary sense of the word. The students having reached that stage of their education when they have learned how to study and when they really wish to study, are to study chiefly by themselves on their special subjects. The professors are to propose problems for them, to advise and to guide them in the study of the problems, to hold conferences with them, but not to teach them. And with the conception of a body of professors devoted chiefly to research in the several departments of a single science and of a body of students devoted chiefly to study in different subdivisions of the same science, you may imagine the atmosphere by which a Graduate School should be enveloped. It is one of the most delightful, most inspiring atmospheres in which human beings can live.

The Preparation of Teachers of Geography

A practical question may however rise in your minds. If the requirements of a Graduate School of Geography are so high, is it likely that any students will wish to enter it? I can give several very confident answers to that question. In the first place, a candidate for the position of teacher in a secondary school ought not to be encouraged to enter it. He acquired during his undergraduate college years as much knowledge of the subjects which he is to teach as he will need; and moreover, inasmuch as a school teacher should be more interested in the boys and girls that he teaches than in the subjects which the boys and girls are to be taught, it is not necessary for him to carry preparatory studies to the point of becoming engrossed in research. In the second place, a candidate for the position of professor of geography in a college should without question be encouraged to enter such a Graduate School of Geography as I have outlined, and to stay there long enough to earn a master's degree at least and a doctor's degree if possible. College professors ought to be learned persons; and as a preparatory step toward becoming learned they

ought to have breathed an atmosphere of learning for a year or two. To be sure, a candidate for a professorship in a college where the teaching of geography is combined with the teaching of another subject may make the other subject his first interest, and may not therefore feel justified in carrying his geographical preparation very far. But it is encouraging to see that geography is coming to be recognized in more and more of our colleges as a subject large enough and important enough to occupy the whole of a professor's time. Young men who have the ambition to be professors of geography in colleges of that grade should be urged to take a doctor's degree in geography; and to young men of that sort the Clark Graduate School of Geography should be powerfully attractive, if it is organized on the lines I have indicated.

GEOGRAPHICAL ENGINEERS

But there is an altogether different group of positions for which young men will be increasingly needed as the affairs of the world, now so disordered, return to a more normal condition, and as, in consequence of that return, international commerce comes to flourish again, particularly those branches of international commerce which have to do with the less known continents of South America, Africa and Asia. At that time, which we may hope will not be too long delayed, many of our larger commercial houses will find, as some of the most enterprising have already found, that they need much more information than is ordinarily available regarding the more distant parts of the world; and they will learn that it is profitable to secure that information from trained experts. In my opinion the experts who can best give that sort of information will be high grade geographers, who have specialized in economic geography as well as in the regional geography of one or another continent.

The Clark Graduate School of Geography ought to make a specialty of training such men: their specialty ought to be called geographical engineering, and those who become proficient in it ought to receive the degree of geographical engineer. Needless to add that training of that kind must be based on a broad and firm foundation of undergraduate studies in a well equipped college, and must be extended by continuing those studies in a thoroughgoing professional School of Geography; and the training will need one other element, namely, after the professional study is well advanced, a year of studious travel in the continent selected for special attention. For although the later work of a geographical engineer must be largely of so practical a nature as to satisfy the money-making demands of commerce, the preparation for that work can not be made by learning definite answers to set questions. The problems that the geographical engineer has to answer will be as a rule so novel, so individual, that his best training for them will be found first in the comprehensive acquisition of all the fundamental knowledge in his specialty, and second in the original study of novel and individual problems in the same specialty, that is, research in economic geography. Hence even for this most practical field of geographical science, experts will be best made ready by close association with older experts who are carrying on researches in the same field. Men who have received high-grade preparation of that kind will be sought for and prized.

THE CLARK SCHOOL A CENTER OF GEOGRAPHICAL ACTIVITY

Can you not imagine the eagerness and earnestness with which the students in a Graduate School of Geography will pursue their studies? They will be proud of their association with a staff of research professors; they will be devoted to their science and delighted with the opportunity that the school affords of advancing themselves in it; they will be ambitious to become proficient in the science and to apply their proficiency to serious tasks in the actual world. Can you not understand also that the presence of such a Graduate School of Geography in Worcester, with its corps of expert professors, its well developed material equipment, its body of enthusiastic students and its exhilarating scholarly atmosphere, will attract intending and returning travelers to visit it, to stay near it for a time, and to establish more or less formal relations with it? An intending traveler may well spend several months under its influence while making preparations for his journey; a returning trav-

eler may advisedly remain an entire year in its wholesome atmosphere while writing his account of an accomplished journey. Can you not see that the school will thus become a notable center of geographical activity if its development follow serious professional lines? It will inevitably become such a center, and it will thereby exert a greatly needed and most beneficent influence on the cultivation of scientific geography all over our country. That the beginning now made should have some such consummation is my devout wish. When that wish is realized, then wherever geography is seriously spoken of in America, the speaker and his hearers will find themselves thinking spontaneously of the Graduate School of Geography at Clark University.

WILLIAM MORRIS DAVIS
HARVARD UNIVERSITY

THE RESEARCHES OF ALFRED GOLDSBOROUGH MAYOR

ALFRED G. MAYOR brought to research an unusual personality. He had an extraordinary artistic sense both for color and form; he had a training in physics and engineering in accordance with a parental desire; he had the brilliancy in conversation that made him an excellent companion on expeditions or after work hours; he had a capacity for meeting peoples of all kinds and conditions—whether in social events in cities or among the natives of the shore of Torres Straits; and he had an industry that outran his strength.

After graduating from Stevens Institute he went to Clark University as assistant to Professor Michelson, and then to the University of Kansas where he taught physics for parts of two years. While there he made biophysical studies on leaves, and published the results after going to Harvard. Mayor's artistic sense lured him to study animals. He had as a boy made the most beautiful paintings of butterflies of iridescent types which looked as though their wings had been pasted on the page. His first research at Harvard was on the development of the wing scales and their pigment in butterflies and moths (1896) and this was quickly followed by a contribution of 87 pages and 10 (for the most part colored) plates "On the color and pattern of moths and butterflies." These papers revealed three major interests of the author: (*a*) a fine artistic sense, with a special attraction toward color; (*b*) a tendency to make crucial experiments to test mooted points; and (*c*) a fondness for physical experimentation. Thus he used in these researches the spectroscope to study the pigments and a pendulum to determine the friction of wing scales on the air. In the latter experiment on butterflies the wings were studied with their scales on and also removed. The later paper stimulated Alfred R. Wallace to discuss it in *Nature*.

Five years later Mayor published further researches on Lepidoptera and analyzed the elements of their color patterns. He returned again to the Lepidoptera in 1906, when he published a paper with Miss Soule on some reactions of caterpillars and moths. He studied not only their reactions to light, food and gravity and their feeding habits but continued the studies he had begun six years earlier on mate selection. Wings of males were painted with scarlet or green ink; and males were variously maimed. Color made no difference with matings but the maimed males met more resistance than normals to copulation unless the female was blinded.

Mayor had not been long at the museum in Cambridge before his artistic work attracted the attention of Alexander Agassiz and led to an invitation to him to accompany Agassiz on his trip to the Bahamas in Mr. Forbes' yacht *Wild Duck* in 1893. This was the first of a series of voyages with Agassiz up to 1900; to the Great Barrier Reef of Australia in 1896; to the Fiji Islands in 1897-8; to the tropical Pacific on the *Albatross* in 1899-1900. On these voyages Mayor made drawings and observations on radiates—especially the Medusæ. These fascinated him as they did that other artist-naturalist, Haeckel. The outcome of these studies and those of later years appeared eventually in Mayor's "Medusæ of the World" and "Ctenophores of the Atlantic," published by the Carnegie Institution and illustrated by scores of plates drawn by his own hand and brush. To this period belonged

his discovery of the "Atlantic Palolo" and his study on the Partulas of Tahiti.

In 1900 Mayor entered on a new phase of work. He was appointed curator of natural science at the new Brooklyn Museum and, in 1904, curator-in-chief. Here he devoted himself to arranging the rapidly increasing collections; and he also continued his studies on Lepidoptera and Medusæ. But museum work was too static for this experimental naturalist. He agitated the establishment of a marine laboratory at the Tortugas (SCIENCE, January 30, 1903) and found the American biologists strongly favored the plan. So it was natural that when the Carnegie Institution of Washington was casting about for the best projects to support it should adopt this and its principal sponsor, Dr. Mayor. In 1905 he published a book, "Sea Shore Life," of which he unselfishly turned the copyright over to the New York Zoological Society; just as he turned over the problem of the Partulas of Tahiti to Dr. H. E. Crampton; and just as he generously gave unsparingly of his time and ideas to others.

And now began a new era in Mayor's life. He erected in July, 1904, laboratory buildings at Loggerhead Key, Florida, and sailed thence from Maine to the Tortugas in the new 57-foot auxiliary ketch, the *Physalia*. Besides providing for the physical care and scientific needs of the zoologists that gathered at the laboratory, Mayor plunged into scientific work. In it he combined his special knowledge of jelly fishes with his fondness for physical and chemical experimentation and showed that rhythmical pulsation may be initiated and maintained independently of the nervous system. During the following seasons he made fundamental studies on the effect of different ions. Thus Mg is stupefying and the NaCl, K and Ca and sea water resist its stupefying effect; many ions have the opposite effect on muscles from that on cilia.

In 1909 the series of "Papers from the Tortugas Laboratory" began to appear, of which 15 large volumes have been published. It took a lot of pertinacious endeavor and much tact on the part of the director to secure a prompt publication of results.

In 1913-14 Mayor made an expedition to Thursday Islands and Murray Islands in Torres Straits, where studies were made on coral reefs, and where he found clear evidence of solution of limestone on the reefs. A summary of the first ten years of work of his department is given in Mayor's report in the *Yearbook* of the Institution for 1914.

Already it had begun to appear that the Tortugas must be abandoned as the permanent site of the laboratory, on account of its destructive hurricanes and its isolation; so Mayor visited numerous other islands to find a better site; also more studies were undertaken in the Pacific Ocean on coral reefs, especially at American Samoa. Later studies were made here upon the theory of coral reef building.

The war seriously interfered with Mayor's scientific work for a year or two—when he was giving much time to instructing naval recruits in navigation. Returning to Samoa in 1919 he demonstrated that the present living coral reefs are not superimposed upon ancient reefs but have simply grown outward from the shore slopes since post-glacial times. Mayor made observations and photographs of corals down to 8.5 fathoms by the use of a diving hood, and it was probably in connection with this trying experience that his resistance was weakened and that illness was started which resulted in his death.

Mayor's scientific influence is not confined to his personal researches; to his activity must be largely ascribed the results of Vaughan's studies on growth of corals, of Bartsch's on hybridization in Cerion, of Drew's on the origin of limestone deposits through bacterial action, of Harvey's on phosphorescent light; and many other researches. The hope may be expressed that since the department which Mayor founded has so amply justified itself the man and means will be found to continue it.

CHAS. B. DAVENPORT

A SCIENTIFIC EXPEDITION TO THE ISLANDS OFF THE WEST COAST OF LOWER CALIFORNIA

THE most important expedition sent out by the California Academy of Sciences this year has sailed from San Diego for a two months'

cruise among the islands off the west coast of Lower California. The expedition has been made possible through the cooperation of the Mexican government with a number of American institutions, including the California Academy of Sciences, the San Diego Museum of Natural History, the Scripps Institution for Biological Research, the National Geographic Society, and the Committee on Conservation of Marine Life of the Pacific of the Pacific Division of the American Association for the Advancement of Science, functioning under authority of the Committee on Pacific Investigations of the Division of Foreign Relations of the National Research Council.

The Committee on Conservation of Marine Life of the Pacific, of which Dr. Barton W. Evermann, director of the Museum of the California Academy of Sciences, is chairman, has for several months been planning this expedition, but not until recently were funds forthcoming to meet the expense. When the matter was placed before the Mexican government it very generously proposed not only to detail their fishery guard boat *Tecate* for the purpose, but also to accept as their guests the naturalists whom the American institutions desired to send on the expedition. The National Geographic Society, always alert to the possibilities of increasing geographic knowledge, became interested in the expedition and has liberally contributed to the fund for meeting the cost of the cruise. With such material aid from these two sources, the proposed expedition has become a reality.

The Mexican government is represented by Sr. Carlos Cuesta Terron, professor of herpetology and biology in the Museo Nacional de Historia Natural de Mexico; Sr. Jose Maria Gallegos, professor of mammalogy and botany in the same institution; Captain Victor Angulo of the *Tecate;* Sr. Jose Rubio, taxidermist; Sr. Gonzales, inspector of fisheries; and Sr. Rodolpho Lazcano, inspector of lighthouses. Professor Terron will be in general charge of the expedition.

The California Academy of Sciences is represented by Dr. G. Dallas Hanna, curator of paleontology and secretary of the Committee on Conservation of Marine Life of the Pacific; Joseph R. Slevin, assistant curator of herpetology, and Frank Tose, chief taxidermist.

The San Diego Museum of Natural History sends A. W. Anthony, curator of vertebrates, and Ernest Hinkley, assistant; and P. S. Barnhart represents the Scripps Institution for Biological Research.

Messrs. Hanna and Anthony will be in immediate charge of the scientific investigations.

The primary purpose of the expedition is to make investigations to determine as fully as may be the present abundance and condition of the southern fur seal, southern sea otter, and elephant seal in the localities visited. It is known that each of those three important and valuable marine mammals was at one time quite common not only about the islands off Lower California but also about the islands on the California coast as far north as the Farallons. Records believed trustworthy show that in the years 1808 to 1811, more than 203,000 fur seals were taken on the Farallon Islands, besides many thousands on the Channel Islands, Cedros, and other islands off the coast of Lower California. Records also show that the southern sea otter was at one time very abundant in the great kelp beds about these same islands, more than 22,000 having been taken prior to 1806. The elephant seal was once abundant on Guadalupe Island and on other islands on this coast.

It is generally believed that each of these interesting animals is now extinct or nearly so; but certain recent discoveries show that at least small remnants of each of the three species still exist. It is the purpose of this expedition to find out the facts in so far as is possible and place them before the State Departments of the United States and Mexican governments in the hope that the necessary steps may be taken by the two governments through an international treaty for the adequate protection of these valuable natural resources.

The scientists of this expedition will avail themselves of the exceptional opportunities for making a general survey of the fauna and flora and geology of the islands visited. They will be equipped for making collections in various branches of natural history, particularly in birds, mammals, reptiles, insects, shells, botany

and fossils. These islands have been but little explored and it is believed that many new species will be discovered. Provision is made for taking photographs, both still and moving, adequate for illustrative and educational purposes.

Cooperation of Mexican and American scientists in an expedition of this kind is most gratifying and will do much toward increasing the friendly relations between the two countries and developing a mutual interest in the conservation of the natural resources of our coastal waters.

On Sunday morning, July 9, the expedition sailed from San Diego, with all the scientific staff on board, and with the American flag flying at the masthead and the beautiful Pabellón Mexicano flying gracefully aft.

SCIENTIFIC EVENTS

THE CHEMICAL FOUNDATION

(American Chemical Society News Service)

THE American Chemical Society, representing some 15,000 men and women working in educational institutions, research laboratories and industrial plants, is preparing to fight to the last ditch to preserve the American chemical industry.

Recent acts on the part of the government have made the necessity for such a fight apparent to this group. In the hope of placing a fair presentation of the views of American chemists before the president, Dr. Edgar F. Smith, former provost of the University of Pennsylvania and now president of the American Chemical Society, appointed a committee to serve with him. Their purpose in seeking a conference with President Harding was to lay before him briefly the far-reaching effects which the contemplated action against the Chemical Foundation will have upon chemistry in America. The committee also desired to have any facts which could properly be given to them in order to guide the society in its future actions. The committee with Dr. Smith as chairman is as follows:

Dr. J. E. Teeple, consulting chemist, New York, treasurer of the American Chemical Society.

Dr. R. H. McKee, head of the department of chemical engineering, Columbia University.

Dr. J. F. Norris, professor of organic chemistry, Massachusetts Institute of Technology, Cambridge, Mass.

Dr. A. D. Little, consulting chemist, Cambridge, Mass., past president of the American Chemical Society and of the American Institute of Chemical Engineers.

E. R. Weidlein, director, Mellon Institute of Industrial Research, Pittsburgh, Pa.

Dr. George D. Rosengarten, director and member advisory committee on national policy, American Chemical Society, Philadelphia, Pa.

Dr. Julius Stieglitz, University of Chicago.

William Hoskins, consulting chemist, Chicago, Ill.

H. E. Howe, editor, *Journal of Industrial and Engineering Chemistry*, member National Research Council.

None of the members of this committee is a dye manufacturer or connected with the Chemical Foundation. The committee believes that the president would not have taken this step if he had possessed full information or had called into conference unprejudiced persons well able to advise him.

American chemists believe in the Chemical Foundation and no facts have been presented thus far by the administration to shake their faith in this institution which has become the nucleus of the organic chemical industry in this country.

The request for a conference with the president was made on July 12, and was followed by two reminders. Not until July 21 was official word received from the White House. It was then stated that the president would be unable to meet such a committee for the present because of the other urgent and imperative matters now before him.

The American Chemical Society is about to hold its annual meeting in Pittsburgh, where the situation will be presented in detail to the governing body at the general meeting. The society is planning a vigorous campaign to have the country understand the true situation. The latest evidence of the necessity for this action is an announcement carried in an Associated Press despatch from Chicago, dated July 18, which makes the significant announcement that the Third German-American Na-

tional Conference adopted resolutions including the following:

We greet with satisfaction the first steps of the administration to correct the iniquities committed by the custodian of alien enemy property.

It is also significant that George Sylvester Viereck was chairman of the resolutions committee. Viereck attracted much attention during the war as a persistent German propagandist.

LECTURES ON SCIENCE AT TEACHERS COLLEGE

TEACHERS COLLEGE, Columbia University, is offering for the summer session of 1922 a special course entitled "Educational Interpretation of Modern Science," under the charge of Dr. Otis W. Caldwell, director of the Lincoln School of Teachers College. The course is open to all students who register and pay the tuition fee. It carries two credit points for those who attend the lectures, and prepare synopses and term papers upon two topics selected from the subjects discussed.

The lectures, which are being given daily in the Horace Mann Auditorium at 2:30 p.m. from July 10 to August 18, are as follows:

"Achievemeents of science," Dr. Otis W. Caldwell.

"Methods and purposes of medical research," Dr. Simon Flexner, director of the Rockefeller Institute for Medical Research.

"Poliomyelitis (infantile paralysis)," Dr. Harold L. Amoss, associate professor of medicine, Johns Hopkins Medical School.

"Epidemic influenza," Dr. Frederick L. Gates, Rockefeller Institute for Medical Research.

"The control, care and treatment of human tuberculosis," Dr. Matthias Nicoll, Jr., deputy commissioner, Department of Health, State of New York.

"Chemistry of Foods," Dr. H. C. Sherman, executive officer of the department of chemistry, Columbia University.

"Influence upon man of climatic conditions and of the physical features of the earth's surface," Dr. W. W. Atwood, president of Clark University.

"Influence of the distribution of natural resources upon human activities," Dr. Atwood.

"Recent advances in long distance telephony," Dr. F. B. Jewett, president of the American Institute of Electrical Engineers and vice-president of the Western Electric Company, and Mr. John Mills, the Personnel Department.

"Chemistry in relation to present day civilization. I. Gasoline. II. Refrigeration. III. Coal tar products. IV. Photography. V. Sugar," Dr. E. E. Slosson, editor of *Science Service*, Washington, D. C.

"The human voice and its electrical transmission," Mr. John Mills.

"Warfare against insects," Dr. L. O. Howard, chief of the United States Bureau of Entomology.

"A modern botanic garden in relation to community needs," Dr. George T. Moore, director of the Missouri Botanical Gardens.

"International health work," Dr. George E. Vincent, president of the Rockefeller Foundation.

"The meaning of evolution," Dr. John M. Coulter, head of the department of botany, University of Chicago.

"Evolution and religion," Dr. Coulter.

"The use of statistics in industry," Mr. R. S. Kellogg, editor of *News Print Service*, New York City.

"What science has done to enlarge our knowledge of the soil," Dr. Milton W. Whitney, chief of the U. S. Bureau of Soils.

"The Endurance of the Soil," Dr. Whitney.

"Forests as economic factors in modern life," Dr. Raphael Zon, forest economist, U. S. Forest Service.

"Forests as physical and biological factors," Dr. Zon.

"Physiological aspects of the modern potato problem," Dr. C. O. Appleman, professor of plant physiology and biochemistry, University of Maryland.

"Physiological aspects of food storage," Dr. C. O. Appleman.

"Vitamins," Dr. Walter H. Eddy, associate professor of physiological chemistry, Teachers College.

PITTSBURGH MEETING OF THE AMERICAN CHEMICAL SOCIETY

THE fall meeting of the American Chemical Society will be held with the Pittsburgh Section on Monday, September 4, to Saturday, September 9, inclusive. All divisions and five sections are planning extensive meetings. The Pittsburgh local committees have already nearly completed their arrangements and an interesting program, together with instructive

excursions, is assured. It is expected that two thousand members will be present. The National Exposition of Chemical Industries meets in New York, September 11 to 16, and members can readily go from Pittsburgh to New York for this meeting.

Following the meeting of the council on September 4, the general program is:

TUESDAY, SEPTEMBER 5

9:00 a.m.—Registration and reception of members and guests at Carnegie Music Hall.

10:30 a.m.—General meeting, Carnegie Music Hall.

Address of welcome.

Response, Edgar F. Smith, president of the American Chemical Society.

General addresses, including the following:

1. J. H. James: "Pittsburgh as an industrial center: historical and industrial."
2. W. F. Rittman: "Pittsburgh as an industrial center: finance and transportation."

2:00 p.m.—General meeting, Carnegie Music Hall. Special addresses will be given, of which the following are part:

1. Thos. Midgley, Jr., and T. A. Boyd: "The chemical control of gaseous detonation with particular reference to the internal combustion engine." (Illustrated by experiments and slides). (One hour). Discussion later in Industrial Division.
2. E. J. Crane: "The journal literature of chemistry."
3. Wilder D. Bancroft:" Structural colors in feathers."

2:00 p.m.—Ladies' trip to Country Club.

8:15 p.m.—Smoker at Syria Mosque. Special features.

8:15 pm.—Drama school play for ladies, Carnegie Institute of Technology.

WEDNESDAY, SEPTEMBER 6

9:30 a.m.—Divisional and sectional meetings, Carnegie Institute of Technology.

10:00 a.m.—The ladies will go to the Heinz Factory and lunch there.

2:00 p.m.—Divisional and sectional meetings, Carnegie Institute of Technology.

4:00 p.m.—There will be a musicale for the ladies in the afternoon at the Twentieth Century Club.

8:15 p.m.—Public meeting, Carnegie Music Hall. Reception by the president and members.

THURSDAY, SEPTEMBER 7

9:30 a.m.-2:00 p.m.—Divisional and sectional meetings at the Carnegie Institute of Technology.

5:00 p.m.—Garden party and supper and social evening with music and dancing at the University of Pittsburgh Faculty Club (Oak Manor), Fifth Avenue and Atwood Street.

FRIDAY AND SATURDAY, SEPTEMBER 8 AND 9

Excursions to industrial plants, etc.

All divisions and sections, as enumerated below, will meet. All divisions and sections will have two full days at their disposal if needed.

The Division of Industrial and Engineering Chemistry will include in its program on Wednesday morning a symposium on "Automatic process control." The chairman, L. W. Parsons, has arranged with various authorities to present papers, many being illustrated, bearing upon the fundamental and practical aspects of the subject.

The Water, Sewage and Sanitation Division will discuss the specifications for lime for water treatment, as a feature of the meeting.

The Biological and the Agricultural and Food Chemistry Divisions will hold a joint symposium on the subject of "Fatty foods," with Dr. David Wesson as chairman. Papers dealing with the preparation, purification, digestibility, adulteration, etc., of various fatty goods are solicited for this symposium. Vitamin papers will be included.

The Rubber Division is planning for the largest meeting in its history, as Pittsburgh is situated near the center of the rubber industry.

The Leather Division has prospects of a very large meeting at Pittsburgh. A symposium on gelatin and colagen will be a feature of the meeting.

The Dye Division is arranging a symposium on "The chemistry of the application of dyes."

The Division of Physical and Inorganic Chemistry will hold a symposium on "Recent advances in applied colloid chemistry," in cooperation with the colloid committee of the National Research Council.

The Petroleum Section hopes to perfect its divisional organization at this meeting, and will hold a short symposium on "Lubrication from the chemists' viewpoint."

A Gas and Fuel Section will hold its initial meeting at Pittsburgh, with A. C. Fieldner as chairman. Several authorities have already agreed to present papers. A symposium on "Combustion" will be held Wednesday after-

noon, with R. T. Haslam, Massachusetts Institute of Technology, as chairman.

The Section of Chemical Education is desirous of being an open forum for settling national questions in chemical education including high school, college, university and industry problems. Bring your problem for discussion. A fifty-word abstract of all papers is required before the paper is presented at the meeting.

The Cellulose Section plans a number of discussions on special topics, such as: (*a*) Cooperative research problems in cellulose chemistry. (*b*) The nature of oxycellulose and its bearing on the artificial silk, viscose and paper industries. (*c*) Dr. Tingle's proposed "Bromine number." (*d*) Absorption of salts by cellulose.

THE SOUTHWESTERN DIVISION OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE third annual meeting of the Southwestern Division, American Association for the Advancement of Science, will be held in Santa Fé, New Mexico, on September 6 to 9 inclusive. It will immediately follow the annual Santa Fé Fiesta.

Three afternoons will be devoted to field meetings; one to a large fossil bed containing remains of extinct animals; another to the ruins at Pecos; and the other to the cliff dwellings at the Rito de los Frijoles, under the direction of Dr. E. L. Hewett.

The Santa Fé museums offer a special archeological and Indian program on the evening of the sixth. The address of the president, Dr. D. T. MacDougal, will be followed by a reception. On the evening of the seventh, the friends and associates of Mr. Springer will present to the State of New Mexico a bust of him, in appreciation of his work in the advancement of science and education.

The scientific papers will be read before five sections:

Physical science: Chairman, Dr. A. E. Douglass, University of Arizona and director of the Stewart Observatory.

Social science: Chairman, K. M. Chapman, artist of the Acheological Museums, Santa Fé.

Biology: Chairman, Dr. E. C. Prentiss, El Paso.

Agriculture: Chairman, Dr. H. L. Kent, president of the New Mexico College of Agriculture and Mechanic Arts, Mesilla Park.

Education and psychology: Chairman, Dr. B. F. Haught, professor of psychology, University of New Mexico.

We wish to extend a cordial invitation to attend this meeting to all members of the association who are spending the summer in the west.

ELLIOTT C. PRENTISS,
Chairman of the Executive Committee

SCIENTIFIC NOTES AND NEWS

PROFESSOR MANGIN, director of the Paris Museum of Natural History, presided over the meeting of the French Association for the Advancement of Science held at Montpellier from July 24 to 29.

SIR JOSEPH J. THOMSON, master of Trinity College, Cambridge, was presented on July 26 with the Franklin Medal by the Franklin Institute of Philadelphia for his "signal and eminent service in science." The presentation was made by the Earl of Balfour.

THE Charles P. Daly Medal for 1922 was presented to Sir Francis Younghusband, president of the Royal Geographical Society, at the Americal Embassy in Great Britain on July 19 by George Harvey, the American ambassador, on behalf of the American Geographical Society. The medal was inscribed "For explorations in northern India and Thibet, and for geographical publications on the Asiatic and African borders of the empire."

AT its commencement in June, Randolph-Macon College conferred the honorary degree of doctor of laws upon Rear Admiral David Watson Taylor, chief constructor, United States Navy, in recognition of his international reputation as a naval architect and his distinguished services to his country. The occasion was the near approach of his retirement from active service. Admiral Taylor is a native of Louisa County, Virginia, and was a student of Randolph-Macon College before entering upon his special training for the navy.

THE degree of doctor of science has been conferred by the University of Manchester on Mr. G. H. Hardy, Savilian professor of geometry and fellow of New College, Oxford, and

on Sir E. J. Russell, formerly lecturer in chemistry at Owens College, Manchester.

THE doctorate of laws has been conferred by the University of St. Andrews on Sir Peter Bedford Scott Lang, emeritus professor of mathematics in the university; Dr. Arthur Lapworth, professor of organic chemistry in the University of Manchester; Dr. Charles Robertshaw Marshall, professor of materia medica in the University of Aberdeen; and Sir Harold Jalland Stiles, regius professor of clinical surgery in the University of Edinburgh.

M. ALBERT RECOURA, professor at Grenoble, has been elected a correspondent of the Paris Academy of Sciences, to fill the vacancy caused by the death of M. Ernst Solvay.

DR. LEGRY, professor of anatomy in the Paris School of Medicine, has been elected a member of the Paris Academy of Medicine in the place of the late M. Ranvier.

IN accordance with an act of the California legislature, a commission of agricultural education has been appointed by the governor to formulate the needs of agricultural teaching and research in California and report to the next legislature. This commission consists of A. C. Hardison, who succeeds the late G. Harold Powell, G. H. Hecke, H. A. Jastro, Senator S. C. Evans, Mark Grimes, R. N. Wilson and Elwood Mead.

DR. HENRY B. WARD, of the University of Illinois, will conduct investigations for the Bureau of Fisheries of the pelican in relation to the fishes of the waters of Yellowstone National Park, with the view of ascertaining to what extent these birds prey upon the fish and whether or not they serve as hosts for the parasite which infests many of the trout of the park waters.

B. LINEBURG, a graduate student at the Johns Hopkins University, has been appointed by the U. S. Department of Agriculture for the summer to conduct work on the responses of bees to lights of various wave lengths and intensities.

THE Rockefeller Foundation has sent a hookwork commission to Honduras. One of its members, Dr. D. B. Wilson, accompanied by Dr. Brizzio, director of public health, has already visited several towns.

DR. CHARLES H. GILBERT, accompanied by Willis H. Rich and W. P. Studdert, sailed from South Bellingham, Wash., on June 1 for the purpose of making a thorough investigation of the Alaska Peninsula Fisheries Reservation to determine whether the present regulations are adequate to keep the fisheries of that district in perpetuity.

PROFESSOR H. H. WHETZEL, who has been for fifteen years head of the department of plant pathology of the College of Agriculture of Cornell University, retired on July 1 from the administrative headship in order to devote his time and energies more fully to teaching and research together with the immediate preparation of one or more text-books. Dr. L. M. Massey, who has been acting head for the past year during Professor Whetzel's absence in Bermuda, succeeds to the permanent position. A correspondent writes: "Cornell was the first American University to establish an independent department of plant pathology and this stands, doubtless, at present as the largest development in its field. It is noteworthy when the leader of a flourishing department like this voluntarily retires from the administrative headship while still in his prime."

PROFESSOR B. M. KOZOT-POLJANSKI, of Dorpat University, Russia, has requested American botanists to exchange papers with him, in order that he may come in touch again with American work. His present address is University Botanical Institute, Woronesh, Russia.

AT a meeting of the Société Mathématique de France in the Sorbonne on July 12, Professor Edward Kasner, of Columbia University, spoke on "Problèmes de géométrie dans la théorie de gravitation Einsteinien."

PROFESSOR G. ELLIOT SMITH, F.R.S., and Professor J. T. Hunter described a reconstruction of the Piltdown skull at a meeting of the Royal Anthropological Institute on June 13.

PROFESSOR C. LLOYD MORGAN, Bristol, has been selected to deliver the Gifford Lectures in the University of St. Andrews in 1922-23

and 1923-24. His subject will be "Evolution, emergent and creative." The first course will begin about the end of next October.

IN memory of the late Dr. Howard M. Fussell, friends, officers and students of the Medical School of the university, have presented his portrait to the university. The formal presentation was made by Dr. David Riesman and the portrait was accepted on behalf of the university by the acting provost, Dr. Josiah H. Penniman. Dr. James M. Anders presided.

THE Mérida branch of the Mexican Medical Association will hold a medical contest in honor of Pasteur. The prizes will consist of medals and diplomas to local physicians who submit the best papers on local diseases and means of control. The prizes will be awarded on December 27, the centenary of Pasteur's birth.

THE portrait medallion of Sir Norman Lockyer, by Sir Hamo Thornycroft, at the Norman Lockyer Observatory, Salcombe Hill, Sidmouth, was unveiled by Sir Frank Dyson, astronomer royal, on July 22.

DR. JOKICHI TAKAMINE, who established the Takamine Research Laboratory at Clifton, N. J., known for his work on diastatic ferments and the active principles of the suprarenel glands, died on July 22. Dr. Takamine was born in Tokyo in 1854.

DR. SIMON NELSON PATTEN, from 1888 to 1917 professor of political economy in the University of Pennsylvania, known for his contributions to economics, including the relations of the natural sciences to sociology, died on July 25, aged seventy years.

THE Honorable Huia Onslow, known for his work on the relations of biochemistry to genetics which he carried on in his private laboratory at Cambridge, has died at the age of thirty-two years.

THE sum of $40,000 has been donated to St. Luke's Hospital, Chicago, by Mrs. John J. Borland in memory of her husband. This fund is to endow a fellowship for clinical investigation and is to be under the immediate supervision of Dr. Joseph A. Capps.

THE late Prince of Monaco has bequeathed sums of one millions francs each to the Academy of Sciences, the Academy of Medicine, the Institut Océanographique, the Institut de Paléontologie Humaine of Paris, and the Musée Océanographique of Monaco.

TEN government departments have appointed representatives on an advisory committee on governmental broadcasting formed at the request of Secretary Hoover to make recommendations on the distribution of government information by radio. A preliminary classification of the kind of information that should be broadcasted from various stations is being made. The committee will meet at frequent intervals to consider the questions that arise through the progress of radio. Dr. S. W. Stratton, director of the Bureau of Standards, is chairman.

AN Associated Press despatch from Moscow states that after a month's negotiations, Leo Kameneff, the acting premier, has definitely refused the American Relief Administration's conditions for feeding the Russian intellectuals as a class. The Commonwealth Fund offered to send food packages to the value of approximately $250,000 to Russia for distribution by the Relief Administration among professors, teachers, doctors, scientists and others selected by the relief authorities. The latter were ready for the government to cooperate in the distribution, but insisted that the final decision as to what persons should receive the packets should rest with the Relief Administration. The government, according to M. Kameneff, is willing to permit the Relief Administration to veto any of the government's selections of beneficiaries, but it is not willing that any outside organization be permitted to assist persons despite a Soviet veto.

THE first meeting of the newly formed Association of Maine Geologists will be held on August 11 in Auburn and Lewiston. Professor Frank D. Tubbs, of Bates College, N. B. Tracy, of Auburn, L. C. Bateman, of the *Lewiston Journal*, and other members of the local committee have arranged a program that will take in all the points of geological interest in the vicinity. These include Mt. Apatite, the source

of much of the feldspar, and of many of the Maine gems and a large variety of minerals; the Lewiston Falls and a number of other localities. It is hoped that the geologists from other parts of New England will take part in the meeting, and it is expected that Professor George P. Merrill, curator of the National Museum at Washington, will deliver an address in the evening. The headquarters of the association will be at the Auburn Chamber of Commerce.

UNIVERSITY AND EDUCATIONAL NOTES

BOWDOIN COLLEGE receives $500,000 under the will of the late Edward H. Blake, of Bangor.

PHILIP A. LEHENBAUER, professor of plant pathology at the University of Illinois, has accepted a position as head of the department of horticulture at the University of Nevada.

DR. FREDERICK C. LEONARD has been appointed instructor in astronomy and mathematics, in charge of the work in astronomy, at the Southern Branch of the University of California in Los Angeles.

PROFESSOR BENJAMIN A. WOOTEN, Ph.D., head of the department of physics at the Alabama Polytechnic Institute, has been elected professor of physics at Washington and Lee University, in the place of Dr. Walter LeConte Stevens, who has been retired and made professor emeritus.

LELAND H. TAYLOR, who received the degree of doctor of science from Harvard in 1922, has been elected to an instructorship in zoology in West Virginia University.

DISCUSSION AND CORRESPONDENCE

CONCERNING THE BOTULINUS TOXIN

RECENTLY Bronfenbrenner and Schlesinger[1] have reported the death of laboratory animals (mice) as a result of the intraperitoneal injection of 3×10^{-21} cc of a solution of the toxin of *B. botulinus*. In a preliminary communication[2] concerning the matter they state that under suitable "conditions of the experiment the *botulinus* toxin which ordinarily kills mice in amounts not smaller than 3×10^{-7} cc can be increased in potency to such an extent that 3×10^{-21} cc occasionally and 3×10^{-18} cc quite regularly kills mice of 18-20 g. in less than 48 hours after intraperitoneal injection. While the total solids of such a minute dose of toxin amounts to only 3×10^{-23} g (this amount also includes the inorganic portion of the medium), the toxic product thus obtained, nevertheless, possesses all the essential characteristics of bacterial toxins," etc.

Because of the smallness of the quantity it seemed worth while to examine some of the consequences involved. Since a gram molecule of any compound contains 6.06×10^{23} molecules then one gram of water or approximately 1 cc would contain $1/18 \times 6.06 \times 10^{23} = \frac{10^{23}}{3}$ molecules and 3×10^{-21} cc would contain $\frac{10^{23}}{3} \times \frac{3}{10^{21}} = 10^2$ molecules

From the quotation given it is apparent that the solution of toxin can not be even a one per cent. solution, but assuming that it is a one per cent. solution and that the molecular weight and density of the pure toxin are the same as those of water then 3×10^{-21} cc would contain only one molecule of toxin. However, the molecular weight is probably higher than that of water and not even one molecule in a hundred would be a toxin molecule. Consequently the average 3×10^{-21} cc quantity of solution would contain no toxin. If one takes the larger quantity, 3×10^{-18} cc, which quite regularly kills mice, and assumes that the molecule has ten times the molecular weight of the water molecule then one hundred molecules of toxin would be present.

In the case of the smaller quantity it is unlikely that at best more than one or two molecules of toxin could have been present and since the animal was killed one seems forced to conclude that the life of an organism is dependent upon the integrity of one or two cells or that the action of the toxin is catalytic and

[1] *Journal American Medical Assn.*, 78: 1519 (1922).

[2] *Proceedings Society Exper. Biology and Medicine*, 19: 1 (1921).

accelerates or inhibits some vital process. In either case a difficulty arises when the probability of a single or even small number of molecules reaching the necessary cells is considered.

RAYMOND L. STEHLE

McGILL UNIVERSITY,
MONTREAL

THE PERIODICAL CICADA

TO THE EDITOR OF SCIENCE: It is probably desirable to record the appearance, in accord with expectation, of brood XIII of the periodical cicada or seventeen-year locust (*Tibicina septendecim*) in the Chicago area this year. Reference to Marlatt's excellent paper[1] enables one to satisfactorily identify the present insects as those of the compact brood described by Fitch as brood 6, by Walsh-Riley as brood III, by Riley as brood V and by Marlatt as brood XIII. In Dr. Gideon B. Smith's manuscript chronology the present brood was listed as appearing "in Winnebago, Monard County, and neighborhood in 1854; again in 1871."

The writer first noted the larvæ April 29 of this year, at which time they were present in great numbers at Flossmoor, occupying their characteristic "chimneys." The adults emerged May 28 in enormous numbers, distributed from at least Batavia and Wheeling to Flossmoor and to Crown Point. Two weeks ago oviposition seemed to be past its crest and at the present time in localities visited the adults have practically disappeared.

The precision of appearance of this brood over a period of seventy years is an interesting instance of the uniformity of developmental tempo under natural conditions.

JAMES NELSON GOWANLOCK
THE UNIVERSITY OF CHICAGO,
JUNE 30, 1922

SOME SIDELIGHTS ON THE LIFE OF RUSSIAN PROFESSORS

IT has been noted on various occasions that the Russian professors and the research men are "book-hungry." Being shut off from the remainder of the civilized world for nearly eight years, they have but very little and very fragmentary knowledge of what has been and is being done in western Europe and America. To work under such conditions is at least very inconvenient. But in reality the situation is much worse. The Russian men of science literally have been "bread hungry" for the past several years. Every one of us who had a chance to talk to Russian refugees heard of stories of bread hunting for four or five hours at a time. Those days, let us hope, have passed. The conditions in Russia are becoming better. But even the so-called "better conditions" are very far from good, as one can judge from the following extracts from a letter which the writer received from a Russian professor in Petrograd:

> Notwithstanding the fact that the salaries are regulated by associations of professionals and continuously raised in parallel with the value of the ruble, yet the highest paid specialist in various departments will receive in May, 1922, nearly 40,000,000 rubles in Soviet paper money, plus the food ration of 36 pounds of flour, 7 pounds of fish and a pound each of salt, sugar and fat, plus (in exceptional cases) special academic portion (a little in excess of one mentioned above). Meantime, according to quotation of Government Bank for May, $100 is equal to $193,000,000 Soviet paper rubles.
>
> But even this meager portion and the pack of worthless money do not come on time, adding further to the discomfort of professional people in Russia.
>
> On account of shortage of funds at the government's disposal, the personnel in all departments is systematically decreasing, the salaries come late as well as the food rations. As a matter of fact, the salaries in our division (of an agricultural experiment station) have not been received for March, while the food ration is just being received for April. [The letter was dated May 27, 1922.]
>
> In the same way, the allowances for current expenses of the experiment station are being decreased and delayed.
>
> In spite of all these conditions, of which I do not think it advisable to talk in detail, we are still alive and continue our research, although, of

[1] Marlatt, C. L.: 1907, "The Periodical Cicada," *Bureau of Entomology Bulletin No. 71*, U. S. Department of Agriculture.

course, not so intensively as in America or other countries.

Sorry to confess, I was unable until now to send you our literature including that which was published during the last few years. Perhaps I will have this possibility in the near future.

Such bits of information fairly well characterize the conditions under which Russian men of science are obliged to live and to keep the "light of knowledge burning," in anticipation of better days for science in Russia.

M. I. WOLKOFF

UNIVERSITY OF ILLINOIS

SCIENTIFIC BOOKS

Genetics, An Introduction to the Study of Heredity. By H. E. WALTER. Revised edition, pp. XVI + 354, 92 figs. The Macmillan Co., New York.

This revised edition of a book originally published in 1913 brings the elemental facts of genetics up to date, and meets at once a need for a popular presentation for the general reader as well as an introduction to the study of heredity for the beginning college student. The enormous progress in this field during the last ten years has necessitated eliminations, additions, and modifications in the former text.

About 82 pages have been added in the present edition, 50 of which form three new chapters. A new chapter on the "Factor Hypothesis" contains much material that was formerly discussed under "Old Types and New," but the rearrangement of materials places the subject matter in a more logical position and allows a distinct and important concept to be treated as a separate unit. Hereditary genes are here classified roughly as single or plural according to ways in which they determine the visible hereditary character. Of the plural genes, the discussion of genetic modifiers is the most important new subject, since modifiers play such a large part in present explanations for the results of selection. An entirely new chapter on the "Architecture of the Germ Plasm" reflects the most important advances made since the original edition was published, and deals with the conceptions and viewpoints based largely on the famous Drosophila experiments, such as linkage, crossing over, the chiasmatype theory, interference, and the arrangement of the genes. The author takes the point of view "that it has been possible in a single chromosome to determine not only the relative arrangement of over thirty genes but also to find out the relative distance between these genes." While the order of the genes may be determined readily, our conclusions as to distances between genes have perhaps outstripped the demonstrable evidence. If two linked genes show 1.5 per cent. recombinations, it still remains to be proved that the low percentage of crossing over is due to or proportional to a short distance between these genes on the chromosome, even in the so-called normal population. Possibly it may be, but there are other alternative explanations. To be sure, the possibility of an accurate localization of hereditary genes in their appropriate chromosomes is attractive and even astonishing. While the hypothesis is alluring, the implications are so grave and important, we must await conclusive proof. A new chapter on "Somatogenesis" points out the problem of biological differentiation which must take place between the invisible genes in the fertilized egg and the Mendelian characters as end products, for during this process many external and internal factors (including endocrines) come into play and contribute to the formation of the somatic characters as we see and study them in pedigreed cultures. The present chapter on "Determination of Sex" introduces much new and important material which was unavailable ten years ago, and substitutes for some of the former discussion which now has only a historical significance, such topics as polyembryony, sex-linked inheritance, nondisjunction of the sex chromosomes, secondary sex characters in relation to hormones, sex intergrades and the like. Excellent diagrams make clear at a glance the distinction between the cases where the males are heterogamic (producing two types of spermatazoa) and those cases in which the females are heterogamic (producing two types of matured ova).

Two radical changes occur in the rearrangement of materials in the new edition. A chapter discussing "Pure Lines and Selection" formerly preceded Mendelism but now more appropriately follows this subject because pure lines and selection can be interpreted best in terms

of Mendelism. The basic facts of cytology were originally treated in the second chapter but now follow the fundamental facts of Mendelism and prepare the way for an interpretation of the "Architecture of the Germ Plasm" according to recent researches.

To reduce mathematical formulæ to a minimum is a decided advantage to the lay reader to whom these are confusing; but it is perhaps disadvantageous for the college student, whom we seem to be shielding from even moderate mental effort by continually simplifying subject matter. Underlying all distributions of characters in assortative matings are certain elementary principles based on probabilities and the theory of simple sampling. When the student looks upon a Mendelian population in these terms, he has the advantage of a general fundamental law rather than the knowledge of an individual case. The general lack of this element in approaching genetic problems is perhaps more keenly felt than any other one thing. For example, the standard deviation is not used "since for mathematical reasons it is more accurate" (p. 27); but it is more convenient, and preferable to the average deviation because of its relation to probable error. Again, the sum of a set of observed frequencies should equal the sum of the calculated frequencies in any given series of observations, but they fail to do so in the table on p. 157. In discussing the practical applications the author states (p. 119) that "when ten differing characters are combined in the parental generation there would result over a million kinds of possible offspring among the hybrids of the second filial generation, $(3+1)^{10} = 1{,}048{,}576$." While such a hybrid would produce 2^{10} kinds of gametes which might combine in $2^{20} = 1{,}048{,}576$ ways, so many duplications of type appear that it is misleading to consider each combination as a separate "possible kind"; and in reality there would be only $2^{10} = 1{,}084$ different visible classes (phenotypes) and $3^{10} = 59{,}049$ classes differing in germinal constitution (genotypes). At some points, there seems to be confusion as to an exact definition of genotype. On p. 109, the author states that "There are then . . . nine different genotypes in any dihybrid cross," *i. e.*, 3^n where n = number of allelomorphic pairs. This definition agrees with the current usage, but is hardly consistent with the usage on p. 153 and p. 159. A number of minor errors which always occur in the most carefully prepared texts will without doubt be corrected in subsequent editions.

The revised edition maintains the same attractive and readable style of the original. The volume as a whole has a broad usefulness in the related fields of sociology, psychology, education and medicine. Many excellent new diagrams, remarkable for their lucidness and pedagogic value, help the reader to visualize complex groups af fact quickly. Even the experienced teacher of genetics will find the volume most suggestive and refreshing.

J. A. DETLEFSEN
UNIVERSITY OF ILLINOIS

SPECIAL ARTICLES

THE EMERGENCY FUNCTION OF THE ADRENAL

WE have recently obtained evidence of an emergency function of the adrenal. In some of this work we have confirmed Cannon[1] and his co-workers, who suggested an emergency function for the adrenal. Our method is a modification of Meltzer's[2] denervated eye reaction. The iris is made sensitive to epinephrin by removal of the superior cervical ganglion. Several days later, in order to eliminate central nervous influence, the ciliary ganglion is removed. We have made a study of sixteen cats by this method.

In most animals prepared in this way, stimulation of the moist pinna by rapidly repeated induction shocks will cause a good dilatation of the denervated pupil. Asphyxia for forty seconds will cause almost maximal dilatation. Exposure to cold (immersion in cold water) will usually cause a very decided dilatation after a few minutes, the rectal temperature decreasing meanwhile. As an illustration, a cat whose rectal temperature was 39.0° C. at the start and whose pupil was 0.13 in. in diameter showed the following changes:

[1] Cannon, W. B.: "Bodily Changes in Pain, Hunger, Fear and Rage." 1915, D. Appleton and Co., New York.

[2] Meltzer, S. J.: *Am. J. Physiol*, 1904, II, 37.

Time	1 min.	3 min.	8 min.	10 min.
Temperature	39.25	38.20	34.30	33.0° C.
Dia. pupil	0.13	0.17	0.34	0.425 in.

After removal of the adrenals and before adrenal insufficiency had time to develop, induction shocks, asphyxia and cold produced little or no effect in the same animals which had previously given good responses with the same stimulation.

Our evidence points conclusively to an emergency function of the adrenal.

FRANK A. HARTMAN
DEPARTMENT OF PHYSIOLOGY,
UNIVERSITY OF BUFFALO

SEALING QUARTZ TO GLASS WITH SILVER CHLORIDE

ALTHOUGH silver chloride has long been used as a cement, the possibility of employing it as a cement for vacuum purposes has perhaps not been thoroughly appreciated. Recent tests have demonstrated that the substance possesses certain qualities desirable in a cement, namely, it melts at 455° C, a relatively high temperature, it adheres to glass and quartz surfaces and forms a joint that does not leak, it does not give off gas in any quantity, and does not decompose readily with time. By means of the silver chloride quartz windows were sealed to glass mercury vapor lamps and gas discharge tubes for use as sources of ultra-violet light.

The silver chloride was prepared by precipitation from an aqueous solution of silver nitrate with sodium chloride. The precipitate was thoroughly washed, dried, and ground to a powder. To fasten a plate of quartz or other material to a glass tube the following simple manipulation was found workable. The end of the glass tube was ground evenly, warmed above 500°C in a bunsen flame and dipped quickly into the silver chloride powder. This adhered to the glass and upon further heating in the flame melted evenly around the end of the tube. The tube was then clamped in an upright position and the plate laid on the top of it. The bunsen flame was carefully played over the tube and the plate until the silver chloride again melted and crawled into optical contact with the plate. Little difficulty was experienced in sealing fused quartz plates to glass tubes, but with plates cut from crystal quartz considerable care was necessary to heat them to the required temperature without fracture. Slow even heating by a furnace would have been better than the bunsen flame. It was found that if the glass tube was either too thin or too thick it was liable to crack near the seal upon cooling. Glass tubing of medium thickness stood the strain well. Of course in such a seal strains exist because of the different heat expansions of quartz and glass, but the fused silver chloride, being tough and not brittle, no doubt yields somewhat and eases the strain.

E. O. HULBURT
IOWA STATE UNIVERSITY

THE NORTH CAROLINA ACADEMY OF SCIENCE

THE North Carolina Academy of Science met at the University of North Carolina at Chapel Hill May 5 and 6. Thirty-five new members were added, making a total of 163. The North Carolina Section of the American Chemical Society and the North Carolina Physics Teachers' Association met at the same time and place. The following officers were elected: (Academy) *President,* Dr. A. Henderson, University; *vice-president,* Dr. H. B. Arbuckle, Davidson College; *secretary-treasurer,* Dr. Bert Cunningham, Trinity College; *executive committee,* Dr. H. N. Gould, Wake Forest College, Professor J. P. Givler, North Carolina College for Women, Dr. B. W. Wells, State College. (Chemists) *President,* Dr. A. S. Wheeler, University; *secretary,* Mr. L. B. Rhodes, Raleigh. (Physics Association) *President,* Dr. A. H. Patterson, University; *vice-president,* W. T. Wright, North Carolina College for Women; *secretary-treasurer,* Professor A. L. Hook, Elon College; *executive committee,* Professors C. W. Edwards, J. B. Derieux and A. F. Roller.

In addition to the address of welcome by President Chase of the university and the presidential address, "The search for the ultimate atom," by Professor J. L. Lake of Wake Forest, the following papers were presented:

The variation of the photoelectric current with thickness of metal: OTTO STUHLMAN, JR.